ODN2000/LE2000

Optical Distribution Node/Line Extender with Two Amplified RF Ports

User Manual

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Contents

1 Preface

1.1 Main Contents

This User Manual consists of the following sections:

1.2 Technical Support

Please contact Pacific Broadband Networks qualified service personnel for all your enquiries about this product.

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2 Precautions

General Warning

WARNING!

This product has an IP67 rating. It is suitable for outdoor applications.

To prevent fire, electrical shock, or permanent damage to the product do not expose this unit to conditions outside its rating.

- The product user manual should be read and understood before any units are put into use.
- Ensure the unit has adequate cooling and ventilation. The unit must be mounted with the heat-dissipating fins vertically-oriented.
- SC/APC 8° angle polished connectors must be used.
- Always replace protective caps on optical connectors when not in use.
- Dangerous voltages are present within the unit at all times.
- Do not operate unit without all covers and panels properly installed.

Cleaning

Use only a damp cloth for cleaning front panel. Use a soft dry cloth to clean the top of unit. Do not use any liquid cleaners of any kind.

Overloading or outage

Unplug the unit and refer all repairs to Pacific Broadband Networks' qualified service personnel.

Only use approved electrical cords. Overloading wall outlets and extension cords may result in a fire or electrical shock.

Servicing

Do not attempt to service this unit yourself.

Refer servicing to Pacific Broadband Networks' qualified service personnel only.

Laser Radiation

WARNING!

Exposure to class 1M laser radiation is possible. Access should be restricted to trained personnel only. Do not look directly at exposed fiber or connector ends when handling optical equipment.

3 Introduction

3.1 Overview

The small and adaptable ODN2000 Optical Distribution Node with two amplified RF ports has been designed to affordably deliver interactive CATV and high capacity DOCSIS services. The ODN2000 is a high performance network device engineered to provide the highest quality transmission of HD video, data, and VoIP services.

The ODN2000 is currently equipped with a Gallium arsenide (GaAs) module that offers a cost-effective and flexible solution to expand networks. The optical node offers two high power RF outputs, each with over 1 GHz of bandwidth.

The ODN2000 deep-fiber node is perfect for the last mile in broadband networks. The small and rugged design makes this unit ideal for fiber-to-the-apartment and fiber-to-the-curb applications. Having versatile modular components allows the ODN2000 to be utilized in many different phases of network deployment. As the network grows, the ODN2000/LE2000 can be upgraded. Unmatched flexibility, combined with a robust housing, makes this a reliable product for designing long-term HFC solutions. Additionally, Node+0 support allows for a reduction in amplifiers, improved reliability, and lower maintenance costs, as well as additional options for future cost-effective upgrades.

The optional DOCSIS transponder remotely monitors and manages the ODN2000 to simplify system maintenance and reduce maintenance costs.

The LE2000 is the basic amplifier model and can be upgraded to a 2-port fiber node (into the ODN2000) by adding the optional reverse transmitter module and forward receiver module.

3.2 Features

- Advanced Gallium Arsenide (GaAs) RF hybrid technology provides excellent performance with two individually amplified high-level outputs with more than 55 dBmV each at 1000 MHz
- High output power supports Node+0 architecture
- Can be seamlessly upgraded from an RF amplifier (LE2000) to an optical node (ODN2000)
- Return-path lasers are available for 1310 nm or for CWDM applications on one return fiber at 1470/1490/1510/1530/1550/ 1570/1590/1610 nm
- Optical transmitter/receiver modules and RF amplifier can be individually installed, removed, or replaced. The modular design reduces downtime and simplifies maintenance
- Standard attenuator/equalizer pad to control both attenuation and equalization

- Dedicated KS 5/8" AC input for remote power. 35-90 Vac power supply
- Optional DOCSIS transponder for ODN2000 remote monitoring and management
- Remotely (provisioned) or locally manageable and upgradeable

3.3 Specifications

Forward Path Optical Performance

Optical wavelength	1200-1610 nm
Input range	−5-3 dBm
Nominal design input	−1 dBm
OAGC (optical input)	−4-2dBm
Optical return loss	＞50 dB

Forward Path RF Performance

Bandwidth	54 / 70 / 85-1000 MHz
RF flatness	±0.75 dB
Output level	> 50 dBmV @ 1000 MHz (ODN2xxx-A)[1]
	> 55 dBmV @ 1000 MHz (ODN2xxx-B)[2]
Return loss	＞16 dB
Impedance	75 Ω
RF output stability	±1 dB

Forward Path Optical Link Performance[3]

CNR (5 MHz NBW)	＞53 dB
CSO	＞65 dB
CTB	＞68 dB
MER	＞37 dB
BER	＜1E−9

Return Path RF Performance

[1] 14 ± 1 dB slope from 85 to 1000 MHz. Optical input −4-+2 dBm, 4% OMI.

[2] 14 ± 1 dB slope from 85 to 1000 MHz. Optical input −4-+2 dBm, 4% OMI.

[3] CNR, CSO, CTB, and MER are loaded with 30 NTSC+124 QAM256 or 30 PAL D/ K+85 QAM256; measured with PBN referenced optical receiver with 10 km single-mode optical fiber 0 dBm.

BER is loaded with 30 NTSC+124 QAM256, 30 PAL D/K+85 QAM256, or 153 QAM256; measured with PBN referenced optical receiver with 10 km single-mode optical fiber 0 dBm.

Bandwidth	5-42 / 55 / 65 MHz
RF flatness	±0.75 dB
Input level	15-20 dBmV
Gain adjustment	1 dB step
Impedance	75 Ω

Return Path Optical Link Performance[1]

NPR≥ 30 dynamic range	＞25 dB
Optical output stability	±0.5 dBm
CNR	＞48 dB
IMD2	＜−52 dBm
OMI	6% @ 20 dBmV input

Connectors

Optical connectors	SC/APC[2], FC/APC, E2000/APC
RF connectors	Cable Entry: 5/8" - 24 thread
	Internal Connectors: 75 Ω Mini SMB
	RF Test points: G-type – male

Generals

Power supply	35-90 Vac; 90-264 Vac mains
Power consumption	1Rx, 44 W; 1Rx＋1Tx, 46 W
Operating temperature	−40 to 65°C (-40 to 149°F)
Storage temperature	−40 to 80°C (-40 to 176°F)
Dimensions (W×D×H)	235×143×307 mm (9.25 x 5.62 x 12.08 in)
Ship size (W×D×H)	310×260×400 mm (12.20 x 10.24 x 15.75 in.)
Weight	ODN2000, 5.7 kg (12.57 lb.); LE2000, 5.1 kg (11.24 lb.)
Ship weight	ODN2000, 6.3 kg (13.89 lb.); LE2000, 5.7 kg (12.57 lb.)
Enclosure IP rating	IP67

[1] Use PBN RRAS-Q @ 0km fiber, -7 dBm input, 6% OMI.

[2] Standard option. Contact a PBN Sales Representative for the availability of other options.

3.4 Model Order Details

ODN2[P][Q][R]-[S]-[T][U][V][W]-[X]-[$Y_1$0]-[Z]	Optical Distribution Node with two amplified RF ports
LE2[P][Q][R]-[S]-[T][U][V]	Line Extender with two amplified RF ports

Accessories

LE2[P][Q][R]-[S]-[T]	RF Amplifier
ODN20-FR-[W]-[Z]	Forward Path Optical Receiver
ODN20-RT-[W]-[Y_1]-[Z]	Return Path Optical Transmitters (5-200 MHz)

Options

P	Type: 0 (RF PAD plug-in)	
Q	Backplane Board Version: 0 (Basic Version)	
R	Output Port Number: 1 (One port output); 2 (Two port output)	
S	HW Performance[1]:	
	A	> 50 dBmV @ 1000 MHz
	B	> 55 dBmV @ 1000 MHz
T	Diplexers	
	0	No diplexers
	1	42/54 MHz
	2	55/70 MHz
	3	65/85 MHz
U	DOCSIS Transponder: 0 (Optional accessory)	
V	Power Supply	
	1	35-90 Vac
	2	50-110 Vac
	3	90-264 Vac with power plug for CN
	4	90-264 Vac with power plug for AU
	5	90-264 Vac with power plug for EU

[1] 30 NTSC+124 QAM256 or 30 PAL D/K+85 QAM256; measured with PBN optical receiver with 10 km single-mode optical fiber, 0 dBm; CSO＞60 dB; CTB＞60 dB.

	6	90-264 Vac with power plug for UK
	7	90-264 Vac with power plug for US
W	Optical Connector	
	S (SC/APC)[1]; F (FC/APC); E (E2000/APC)	
X	Forward Path Receiver	
	0	No receiver
	1	One receiver
$Y_1$0	Return Laser Transmitter	
	0	No return transmitter
	A	1310 nm DFB laser, 0 dBm (1 mW)
	B	1310 nm DFB laser, 3 dBm (2 mW)
	C	1310 nm DFB laser, −4 dBm (0.4mW)
	N	1470 nm CWDM DFB laser, 3 dBm (2mW)
	P	1490 nm CWDM DFB laser, 3 dBm (2mW)
	Q	1510 nm CWDM DFB laser, 3 dBm (2mW)
	R	1530 nm CWDM DFB laser, 3 dBm (2mW)
	S	1550 nm CWDM DFB laser, 3 dBm (2mW)
	T	1570 nm CWDM DFB laser, 3 dBm (2mW)
	U	1590 nm CWDM DFB laser, 3 dBm (2mW)
	V	1610 nm CWDM DFB laser, 3 dBm (2mW)
Z	Model Number: 1	

Table 3-1 Return laser transmitter order examples

Code ($Y_1$0)	Description
00	No return transmitter
C0	One return transmitter; CWDM DFB 1310 nm, 0.4 mW
Q0	One return transmitter, CWDM DFB 1510 nm, 2 mW

[1] Standard option. Contact a PBN Sales Representative for the availability of other options.

Other Accessories

High Pass Filters

ODN20-HPF-54	54-1000 MHz
ODN20-HPF-70	70-1000 MHz
ODN20-HPF-85	85-1000 MHz

Low Pass Filters

ODN20-LPF-42	5-42 MHz
ODN20-LPF-55	5-55 MHz
ODN20-LPF-65	5-65 MHz

RF Diplexers

ODN20-DPL-4254	42 / 54 MHz
ODN20-DPL-5570	55 / 70 MHz
ODN20-DPL-6585	65 / 85 MHz

Power Supply

ODN20-PS-90	35-90 Vac
ODN20-PS-264-CN	90-264 Vac with power supply for CN
ODN20-PS-264-AU	90-264 Vac input power supply for AU
ODN20-PS-264-EU	90-264 Vac input power supply for EU
ODN20-PS-264-UK	90-264 Vac input power supply for UK
ODN20-PS-264-US	90-264 Vac input power supply for US

Attenuator/equalizer pad (0-1000 MHz):

ODN20-ATT-xx	xx = 0 dB to 30 dB in 1 dB steps[1]

[1] If the pad is used as an equalizer, "xx" indicates an equalization value. If the pad is used as an attenuator, "xx" indicates an attenuation value.

4 Technical & Module Description

4.1 Technical Description

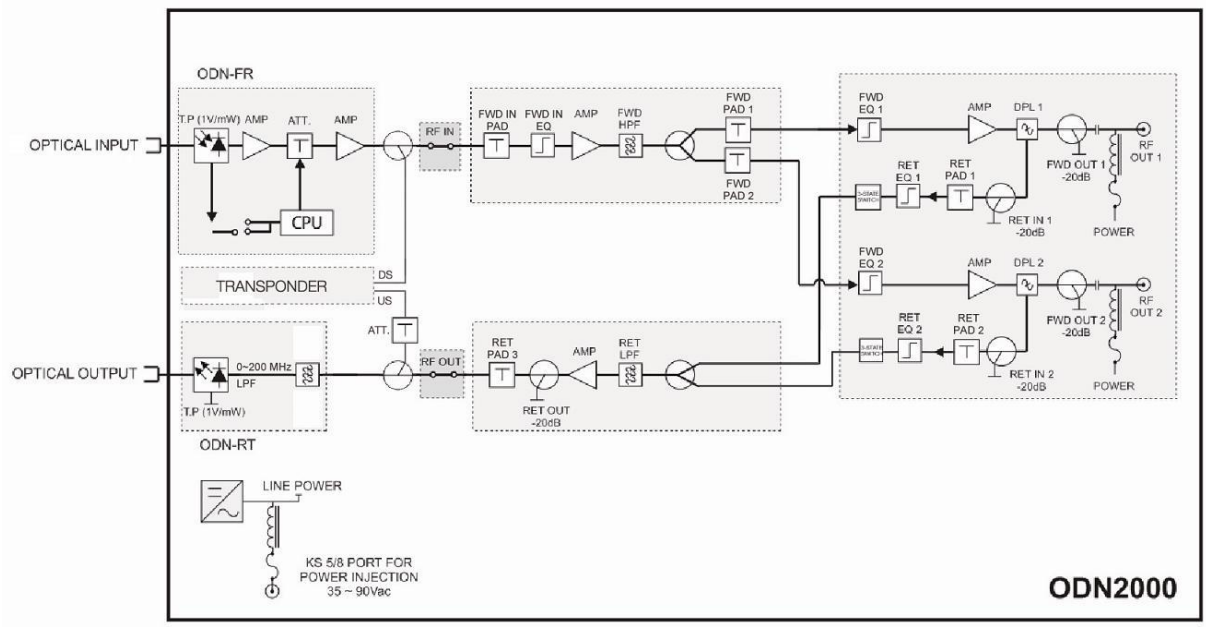

Figure 4-1 ODN2000 Block Diagram

Table 4-1 ODN2000 node circuit components

#	Part name	Description
1	OPTICAL INPUT	Optical input signal
2	ODN-FR	Forward path receiver
3	T.P. (1V/mW)	Optical power test point (1 V/mW)
4	AMP	Amplifier
5	ATT	Attenuator
6	CPU	Central processing unit
7	RF IN	RF input
8	FWD IN PAD	Forward path attenuator
9	FWD IN EQ	Forward path equalizer
10	FWD HPF	Forward path high pass filter
11	FWD PAD 1	Port 1 forward path attenuator
12	FWD PAD 2	Port 2 forward path attenuator
13	FWD EQ 1	Port 1 forward path equalizer
14	FWD EQ 2	Port 2 forward path equalizer

#	Part name	Description
15	DPL 1	Port 1 diplexer
16	DPL 2	Port 2 diplexer
17	FWD OUT 1	Port 1 forward path RF output test point (−20dB)
18	FWD OUT 2	Port 2 forward path RF output test point (−20dB)
19	POWER	Power feed switch for subordinate equipment
20	RF OUT 1	Port 1 RF output signal
21	RF OUT 2	Port 2 RF output signal
22	RET IN 1	Port 1 return path RF input test point (−20dB)
23	RET IN 2	Port 2 return path RF input test point (−20dB)
24	RET PAD 1	Port 1 return path attenuator
25	RET PAD 2	Port 2 return path attenuator
26	RET EQ 1	Port 1 return path equalizer
27	RET EQ 2	Port 2 return path equalizer
28	INGRESS CONTROL SWITCH	3-state switch (0 dB, 6 dB, 31.5 dB)
29	RET LPF	Return path low pass filter
30	RET OUT	Forward path RF output test point (−20dB)
31	RET PAD 3	Port 3 return path attenuator
32	RF OUT	RF output
33	ODN-RT	Return path optical transmitter (return laser transmitter)
34	LPF	Low pass filter
35	ATT.	Voltage controlled attenuator
36	TRANSPONDER	Network management transponder
37	DS	Downstream
38	US	Upstream
39	OPTICAL OUTPUT	Optical output signal
40	LINE POWER	(Node) power supply
41	KS 5/8 PORT FOR POWER INJECTION 35-90 Vac	KS 5"/8" port for 35-90 Vac power supply

4.2 Internal Layout

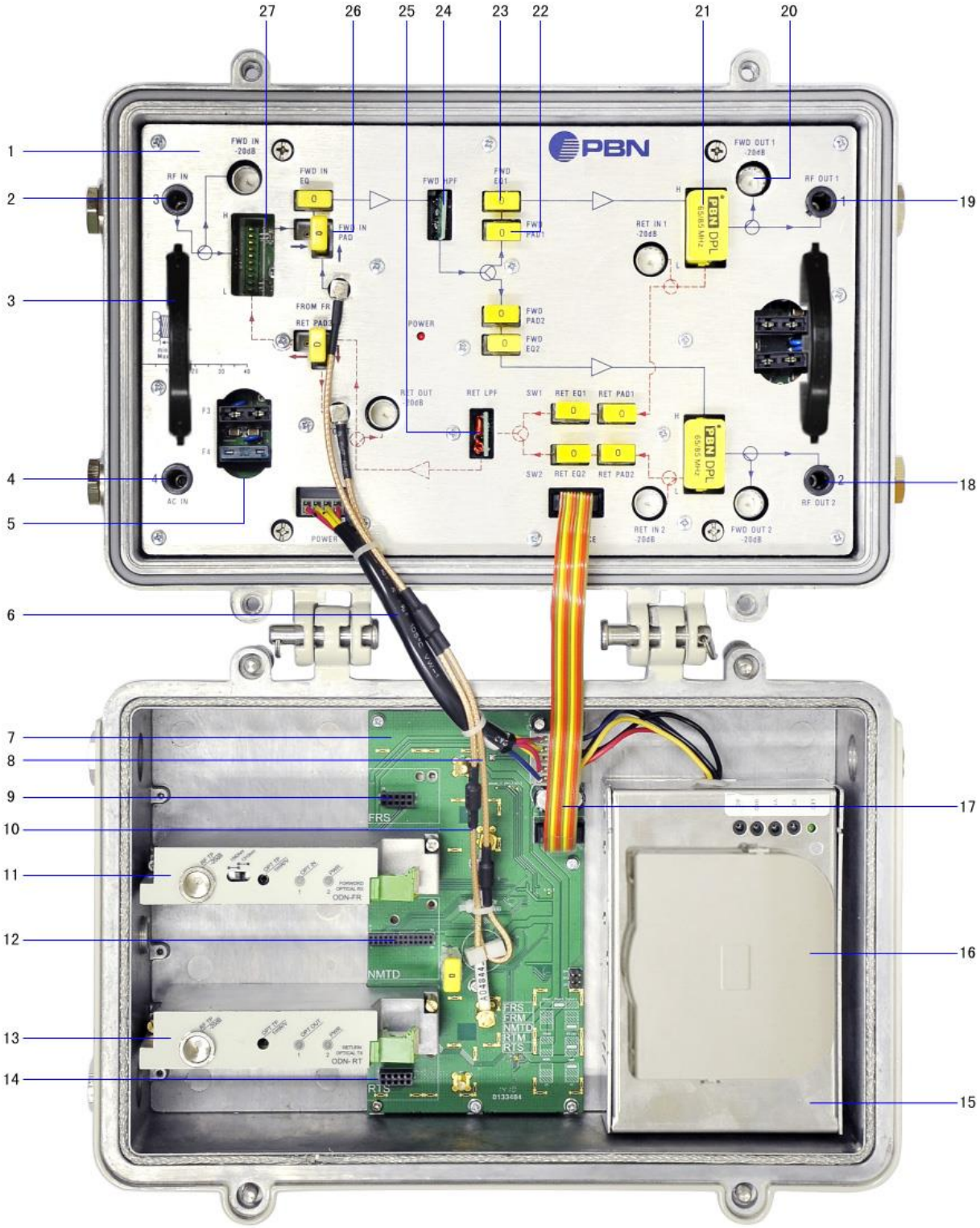

Figure 4-2 ODN2000 Internal Layout

Table 4-2 ODN2000 components and their functions

#	Part name	Description
1	RF amplifier	
2	RF input port	Used with an LE2000 amplifier
3	Handle	
4	60 Vac power input	60 Vac power supply
5	Breakers	Plug-in, blade-type fuses to allow internal (F3, F4) or external (F1, F2) power.
6	Power cord	
7	Backplane	
8	Forward path transmission line	
9	Forward path receiver input - slave (FRS)	Temporarily unavailable
10	Return path transmission line	
11	Forward path receiver input - master (FRM)	
12	NMTD	DOCSIS network management transponder port
13	Return path receiver input - master (RTM)	
14	Return path receiver input - slave (RTS)	Temporarily unavailable
15	Power module	
16	Optical fiber module	
17	Data cable	
18	Port 2 RF output	
19	Port 1 RF output	
20	RF test point	
21	Diplexer	
22	Attenuator	
23	Equalizer	
24	High pass filter	
25	Low pass filter	
26	L-shaped port for attenuator pad	For LE2000, plug in the attenuator pad horizontally. For ODN2000, plug in the attenuator pad vertically (as shown in Figure 4-2).
27	Diplexer	Used in an LE2000 amplifier

Note:

The item names given in Section 4.1 (RF IN, FWD IN EQ, RET PAD1, etc.) apply to ODN2000 RF amplifier components and are not repeated here. See Section 4.1 Technical Description for more details.

Due page space limitations, only one component is marked when there are several components of the same type.

4.3 Power Module Panel

Figure 4-3 Power Module

Table 4-3 Power module panel components and their functions

#	LED Indicator	Description
1	AC Input Voltage Test Point (AC60V)	Test 60 V and 220 V AC input voltage
2	DC Output Voltage Test Point (24V)	Test 24 V DC output voltage
3	DC Output Voltage Test Point (8V)	Test 8 V DC output voltage
4	Ground Point (GND)	A ground reference point to measure input and output voltages
5	Power LED (LED)	OFF - no power; GREEN - module powered.

4.4 ODN-FR Top Panel

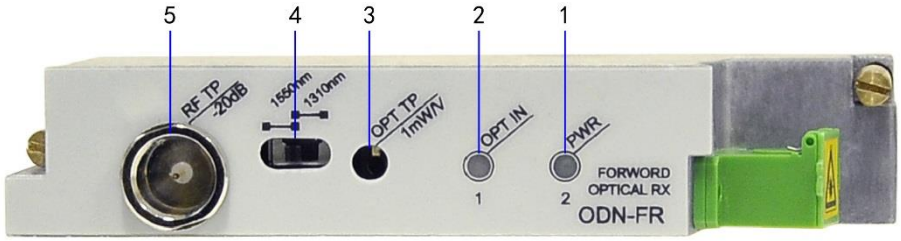

Figure 4-4 ODN-FR Top Panel

Table 4-4 ODN-FR top panel components and their functions

Item	Part name	Function
1	Power LED	OFF - no power; GREEN - module powered.
2	OPT IN LED	OFF - no alarm state; GREEN - receiver optical power level is within range of −2 to 2 dBm; AMBER - receiver optical power is slightly outside of range: too low or high (−2 to −5 dBm or 2 to 3 dBm); RED - receiver optical power is too low or high (≤−5dBm or ≥3dBm).
3	Optical Power Test Point (OPT TP)	1 V/mW
4	Wavelength Switch	Switches between 1550 nm and 1310 nm.
5	RF Test Point	−20 dB test point for checking the FR output level. It is rated as -20dB from the actual output level.

4.5 ODN-RT Top Panel

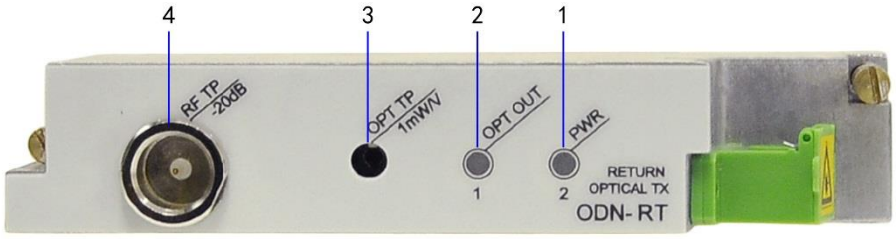

Figure 4-5 ODN-RT Top Panel

Table 4-5 ODN-RT top panel components and their functions

Item	Part name	Function
1	Power LED	OFF - no power; GREEN - module powered.
2	OPTICAL OUTPUT	OFF - no power; GREEN - transmitter optical output signal is within range; RED - no or weak optical output signal.
3	Optical Power Test Point (OPT TP)	1 V/mW
4	RF Test Point	−20 dB test point for checking the RT output level

4.6 Attenuator/Equalizer Pad

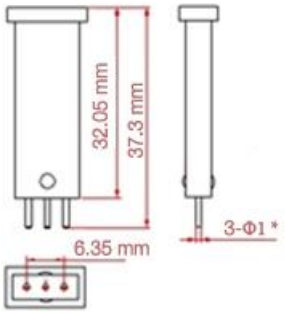

Figure 4-6 Attenuator/Equalizer Pad

Attenuator pad ODN20-ATT-xx is used in both ODN2000/LE2000 in RF output attenuation and equalization. If the pad is used as an equalizer, "xx" indicates an equalization value. If the pad is used as an attenuator, "xx" indicates an attenuation value.

Figure 4-7 shows equalization slope characteristics. If an equalizer value "xx" is set to zero (0 dB equalization), there will be no RF attenuation or frequency-dependent variations in RF output levels. If an equalizer value other than 0 dB is used, there will be some inherent insertion loss introduced along with the equalization slope. The slope value between the lowest (b_{45}) and highest (b_G) frequencies corresponds to the equalization value. As the use of an equalization value other than 0 dB may cause slight RF output attenuation even at the highest frequency, RF output level at b_G may be lower than that at a_G.

Table 4-6 outlines the approximate attenuation introduced by ODN20-ATT-08 and ODN20-ATT-12 across a range of frequencies.

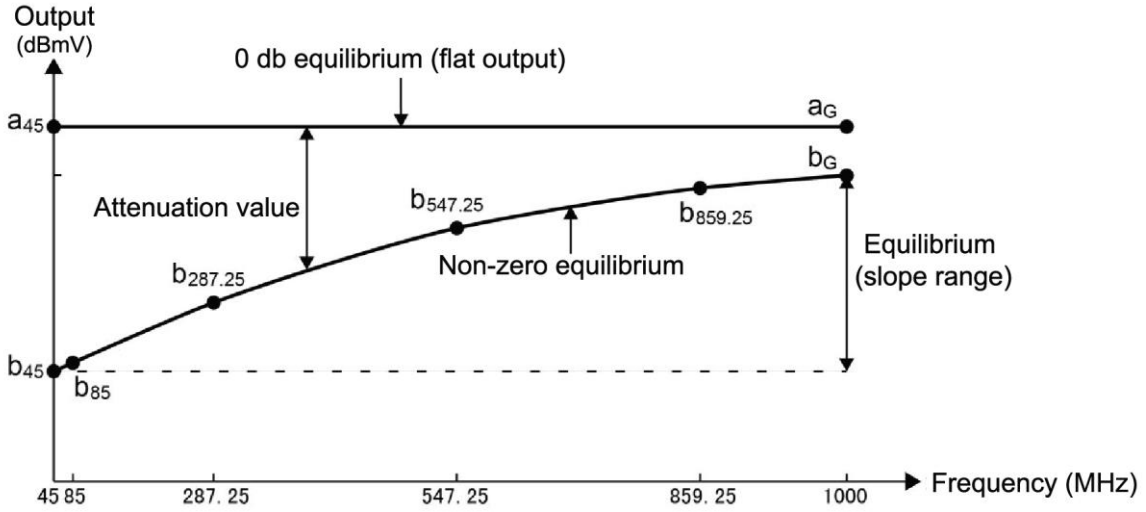

Figure 4-7 Equalization Slope Characteristics

Table 4-6 Attenuation (dB) introduced by ODN20-ATT-08 and ODN20-ATT-12 equalizers

Pad Type / Reference Frequency	ODN20-ATT-08	ODN20-ATT-12
85 MHz	7.4	11.2
287.25 MHz	5.3	7.7
547.25 MHz	2.8	3.8
859.25 MHz	0.8	0.9
1000 MHz	0.2	0.2

4.7 External RF Connectors & Mounting Holes

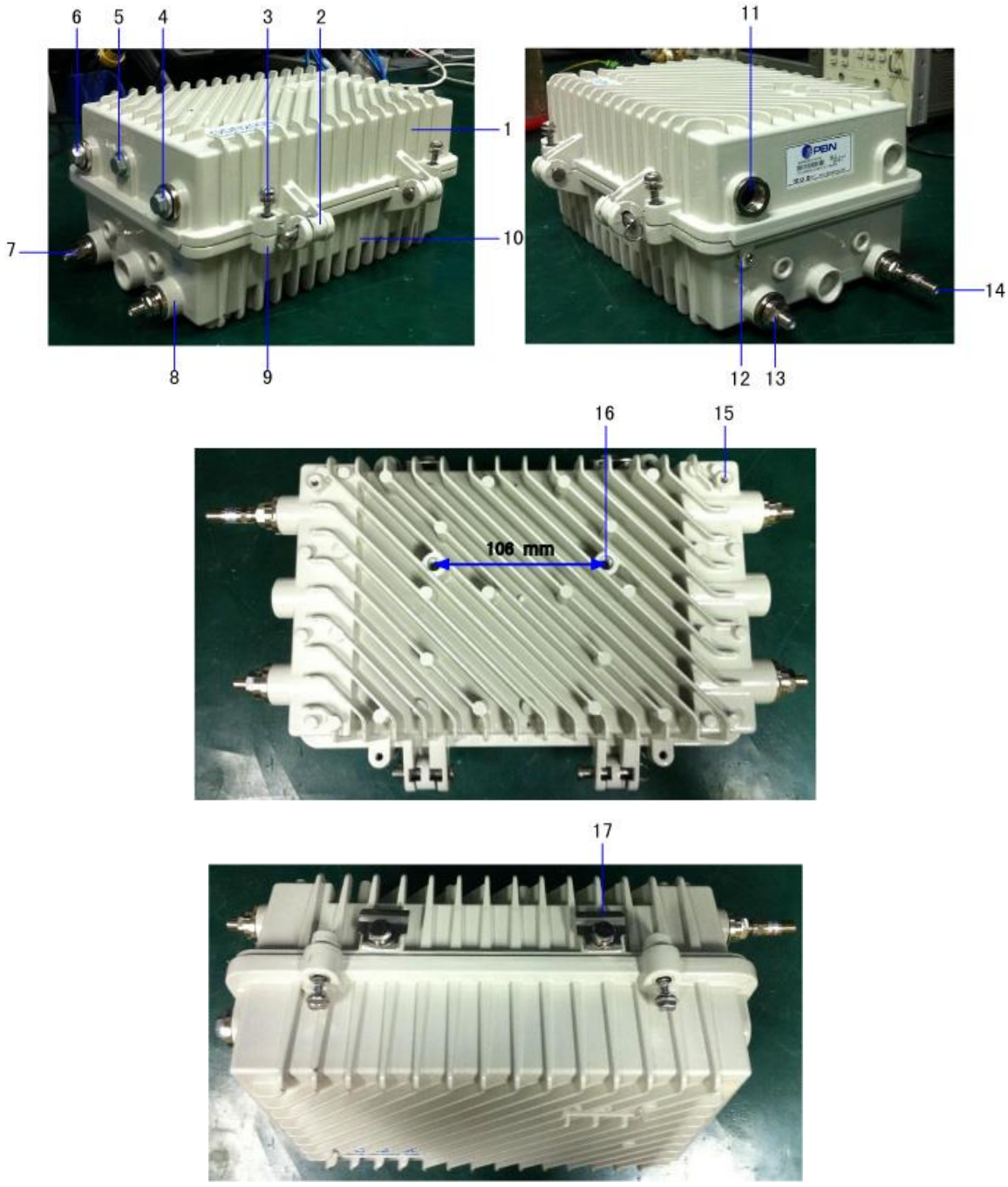

Figure 4-8 ODN2000 External RF Connectors & Mounting Holes

Table 4-7 ODN2000 external RF connectors & mounting holes

#	Part name	Description
1	Front of the node casing	
2	Hinges	
3	Pedestal mounting bolts	4

#	Part name	Description
4	Optical input port	
5	Modem port	
6	Optical output port	
7	RF input port	Used in an LE2000 amplifier
8	60 Vac power input	For 60 V power supply
9	Mounting holes for lid-to-base bolts	Located on the front and back of the node casing (4 on each side)
10	Back of the node casing	
11	220 Vac power input	For 220 V power supply
12	Ground point	
13	Port 2 RF output	
14	Port 1 RF output	
15	Mounting holes	For wall mounting
16	Mounting holes	For wall mounting (distance between the mounting holes: 106 mm)
17	Strand clamps	Used for strand mounting and have grooves for suspension cables

5 Installation

5.1 Equipment Inventory

On receiving your new ODN2000 or LE2000, carefully unpack and examine the contents for any missing or damaged parts (Table 5-1). Refer to your warranty if loss or damage has occurred.

Table 5-1 Packaging content

Item	Description	Qty
Device purchased (ODN2000 or LE2000)		1
Certificate of Performance (includes test result sheet)		1

5.2 Packaging and Transportation

Use only the original packaging of the ODN2000/LE2000 when transporting.

Keep all boxes and packaging, designed specifically to protect the equipment, for future transport of the ODN2000/LE2000.

5.3 Installation

5.3.1 Node Installation Pointers

- A clearance of 50 mm must be left between all sides of the node and any obstruction.
- Avoid installing the node near any sources of water, such as air-conditioning drain outlets or roof gutters. If it must be installed near water, a waterproof board should be installed 35 cm above the node.
- The node MUST be properly grounded.
- Ensure that the attenuator/equalizer pads are installed in the correct orientation and pushed in firmly. Frequency response and RF performance will be affected if the pads are not installed correctly.
- Ensure that the pads are installed in the correct orientation and pushed in firmly. The internal RF PADs within the ODN2000 and LE2000 are terminated with 75 Ω mini-SMB connectors. These connectors must be handled carefully as they can be easily damaged.

5.3.2 Mounting

5.3.2.1 Strand Mounting

Each ODN2000 node has two strand clamps with grooves (Item 17 in Figure 4-8). The ODN2000 node can be mounted via a suspension cable running through the two clamps.

Figure 5-1 Strand Mounting[1]

Note:

Do not hang the node from any wires or electrical cables. Use only a dedicated suspension cable that is rated to hold the weight of the node.

5.3.2.2 Wall Mounting

An ODN2000 node can be mounted on the wall via two mounting holes (located 106 mm from one another) on the rear of the node. There should be enough clearance left below the node to allow maintenance and troubleshooting.

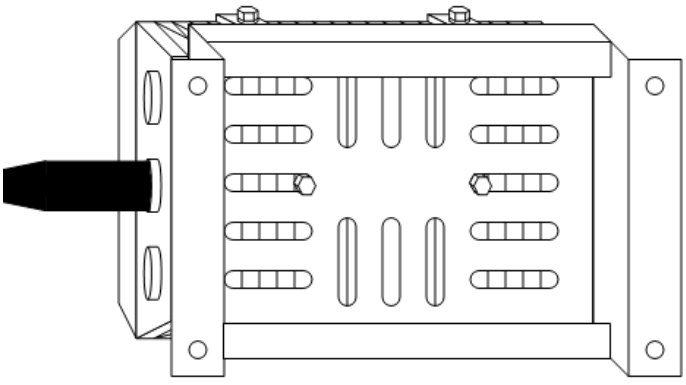

Figure 5-2 Wall Mounting

Note:

Mounting brackets and associated hardware are NOT supplied by PBN.

[1] The figure shows an ODN4P node for illustration purpose; ODN2000 nodes are strand-mounted in the same way.

5.3.3 Cable Routing

5.3.3.1 Applying AC Power

The ODN2000 may be directly line powered via the dedicated 60V AC power input. When plugging in the power connector, please make sure that the center pin is between 35 and 40 mm in length when measured from the seating area of the connector to the tip of the center pin. If the pin is longer, there is a risk of damaging the ODN2000.

A fuse must be plugged into breaker F4 to provide internal power.

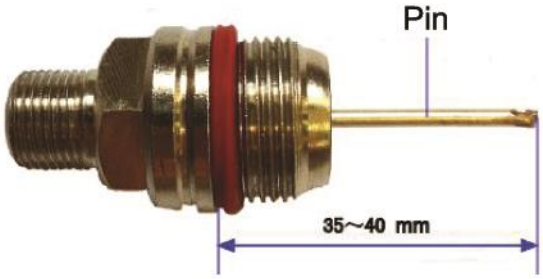

Figure 5-3 The Center Pin of a Connector

Figure 5-4 Fuse

Follow the procedure below to supply 60 Vac AC power to the ODN2000:

a) After removing the protective cap, insert the pin connector into the ODN2000 power supply port. Ensure that the pin is connected into the power supply on the PCB rated at 60 Vac. Before inserting the connector, affix an O-ring to seal the connection and prevent water from entering.

b) Tightly screw the connector into the power supply port.

c) Attach the 60 Vac power adapter cable to the connector.

d) Ensure that a fuse is inserted into breaker F4.

e) Verify that the power module status LED is ON (GREEN). GREEN indicates that the power module is on; if the LED indicator is OFF, check for any problems with the power adapter or power supply.

f) Verify that the forward path receiver and return path transmitter power supply LED indicators (PWR) are ON (GREEN). GREEN indicates that the module is powered; if the LED indicator is OFF, check whether the power module, power adapter, and power supply are functioning normally.

5.3.3.2 RF Input/Output Cable Routing

The ODN2000 RF output ports 1 and 2 are used for forward path output signals and return path input signals. External RF connectors should be inserted into these ports. Please make sure that the center pin is between 35 and 40 mm in length when measured from the seating area of the connector to the tip of the center pin (Figure 5-3 in Section 5.3.3.1 Applying AC Power).

If the node is used to supply power to cascaded equipment, insert fuses into breakers F1 and F2 as required for the RF output ports.

Note:

If outgoing power is not needed, remove the fuses to avoid damaging any internal components.

5.3.4 Optical Stub Cable

CAUTION:

General Warning

Equipment installers are responsible for the correct installation of optical stub cables, optical fibers, and all RF terminators. Failure to properly adhere to the instructions and recommendations herein may affect RF performance or cause the optical node to fail. This type of damage voids the warranty provided by Pacific Broadband Networks.

Optical connector ferrules should be no longer than 1.5 cm in order not to affect the node operation.

Note:

Heat the ODN2000 node prior to installation of optical stub cables. Make sure to run enough optical fiber length inside the node so that it is not taut when opening the case.

The optical modulation index (OMI) of a PBN LTM13 laser transmitter module is 4%[1] (factory setting).

5.3.4.1 Optical Input Port Cable

The optical input cable is connected to the ODN-FR via the ODN2000 optical input port. The ODN-FR allows an optical input level between −5dBm and -3dBm. It has OAGC range between −4dBm and -2 dBm and output level of 20 dBmV.

Optical Input Port Cable

Follow the procedure below to install the optical input cable:

a) Before connecting fiber to the receiver, measure the optical input level with an optical power meter. The optical input level should be between −5 dBm and +3 dBm (level between−2dBm and -2 dBm is recommended). **Higher optical input levels may cause damage to the optical receiver tubes.**

b) Insert the optical cable into the ODN2000 optical input port.

c) Mount the waterproof conduit and place the fiber cable end in the optical fiber module. The sealing O-ring must be on the connector and in good condition. Apply heat shrink tubing or sealing tape.

[1] Test conditions: 77 channels, NTSC

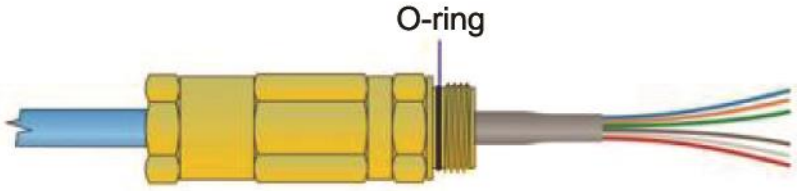

Figure 5-5 Optical Stub Cable Sealing

d) Use a multi-meter to measure the actual optical input level at the ODN-FR optical power test point (OPT TP). The conversion from optical input level (W_{IN}) in dBm to Volts at the optical input test point (V_{TPI}) is:

$$W_{IN} = 10 \lg V_{TPI}$$

e) Ensure that the optical input level is within the acceptable range. If it is too low or too high (indicated by an ORANGE or RED receiver optical power LED indicator), adjust the optical input level and repeat the steps d-e until it is within the acceptable range (indicated by a GREEN receiver optical power LED indicator).

f) Measure RF output level at the ODN-FR RF output test point. The forward RF output level should be 20 dBmV.

Setting the Forward RF Output Level & Slope

Follow the procedure below to set up the forward RF output level and slope:

a) ODN-FR RF output is the RF input for the RF amplifier. Factory set to 20 dBmV at 547.25 MHz.

b) Place equalizers in the “FWD IN EQ”, "FWD EQ1", and "FWD EQ2" locations on the RF amplifier. "FWD IN EQ" is the main circuit equalizer and can be simultaneously used for equalization of two output ports. "FWD EQ1" and "FWD EQ2" are branch circuit equalizers and are used separately for equalization of second output ports. Set equalization values to 0 dB to ensure a flat forward RF output level.

c) Place 0 dB attenuators in the "FWD IN PAD", "FWD PAD1", and "FWD PAD2" locations on the RF amplifier. Measure RF output levels at the "FWD OUT1" and "FWD OUT2" test points and select the desired equalization slope values and characteristics.

d) Place attenuators in the “FWD IN PAD”, "FWD PAD1", and "FWD PAD2" locations on the RF amplifier. Output test point should be 20dB below each of the main output ports. Measure to ensure that the level at this point is no more than 50dBmV at 547.25 MHz.

e) Measure RF output levels at the "FWD OUT1" and "FWD OUT2" test points to check whether they meet requirements.

f) If Ports 1 and 2 are used as a forward power feed, please insert fuses into respective locations (F1 and F2).

Note:

Please terminate unused port with a 75 Ω terminator.

Setup Example for Forward RF Output Levels & Slope

Condition	Output Requirements
Optical input level of −1 dBm	Required output power for Ports 1 & 2 is 45 dBmV at 547.25 MHz Equalization on Ports 1 & 2 is to be 0 dB Port 1 is used for providing power

The following setup is recommended:

a) ODN-FR optical input level is set to the nominal level of −1 dBm. ODN-FR RF output level is set to 20 dBmV at 547.25 MHz, i.e., the amplifier's RF input level is 20 dBmV at 547.25 MHz.

b) Place 0 dB equalizers in the “FWD IN EQ”, "FWD EQ1", and "FWD EQ2" locations on the RF amplifier.

c) Place 0 dB attenuators in the "FWD IN PAD", "FWD PAD1", and "FWD PAD2" locations on the RF amplifier. Measure Port 1 and Port 2 RF output levels at the "FWD OUT1" and "FWD OUT2" test points. For this example, assume the RF levels are found to be 30 dBmV at 547.25 MHz, i.e., RF output levels present at Ports 1 and 2 are 50 dBmV at 547.25 MHz.

d) Place a 5 dB attenuator in the "FWD IN PAD" location on the RF amplifier and measure RF output levels. For this example, assume the RF levels are found to be 25 dBmV at 547.25 MHz, i.e., RF output levels present at Ports 1 and 2 are 45 dBmV at 547.25 MHz.

e) Place a 15 Amp fuse in the F1 breaker to allow power to pass through Port 1.

5.3.4.2 Optical Output Port Cable

Setting the Return RF Input Level & Slope

Prior to connecting the optical cable to the optical output port, use the following procedure to set the return RF input level and slope:

a) Measure return RF input levels at "RET IN1" and "RET IN2" test points.

b) Place equalizers in the "RET EQ1" and "RET EQ2" locations on the RF amplifier. "RET EQ1" and "RET EQ2" are branch circuit equalizers that are used separately for equalization of RF input and output signals. Set equalization values to 0 dB to ensure a flat return RF input level.

c) Place 0 dB attenuators in the "RET PAD1", "RET PAD2", and "RET PAD3" locations on the RF amplifier. Measure return path output levels at the "RET OUT" test point.

d) Compare RF input and output levels obtained from "RET IN1" and "RET OUT" test points, as well as those obtained from "RET IN2" and "RET OUT" test points. Determine attenuation values and slope characteristics for "RET EQ1” and "RET EQ2" equalizers.

e) Based on the selected equalization parameters, set the attenuation values for "RET PAD1", "RET PAD2", and "RET PAD3" attenuators to achieve 37 dBmV[1] ODN-RT RF input level. Consider the loss introduced by the return combiner.

f) Place attenuators with selected attenuation values in the "RET PAD1", "RET PAD2", and "RET PAD3" locations.

g) The RF test point on the ODN-RT should be used to verify that the correct RF signal level is being received. If the RF input level deviates considerably from the required level of 37 dBmV, repeat steps e-g.

Note:

RF amplifier's return gain is set to 26 dB.

Optical Output Port Cable

Procedure to install the optical output cable:

a) Prior to connecting the optical cable to the optical output port, use a multimeter to measure the actual optical output level at the ODN-RT optical power test point (OPT TP). The conversion from optical output level (W_{OUT}) in dBm to Volts at the optical output test point (V_{TPO}) is:

$$W_{OUT} = 10 \lg V_{TPO}$$

b) Compare the optical output level obtained from the test point with the nominal value set for ODN-RT. If the difference between the two is small, proceed to the next step; if the difference is big, please contact PBN's qualified service personnel.

c) Connect the optical fiber to the ODN2000 optical output port.

d) Mount the "waterproof pipe" and place the fiber cable end in the optical fiber module. The sealing O-ring must be on the connector and in good condition. Apply heat shrink tubing or sealing tape (Figure 5-5).

5.3.5 Closing the Node

Before commissioning the node, please check that the following screws are firmly and securely tightened.

- Two mounting screws on each optical receiver.
- Two mounting screws on each optical transmitter.
- The mounting screws for any optional modules.
- The 2 main chassis mounting screws.

Some of the module mounting screws have metal spacers. They should be checked to ensure that they are present and are secured so they are screwed all the way in and are touching the module.

[1] The optimal RF input level for the return-path transmitter is 37 dBmV at 6% OMI.

When installing a module, tighten the mounting screws in steps.

Prior to closing the node, inspect the surfaces of the metal mating edge and the opposing rubber sealing gasket. The ridge must be continuous and not damaged or scratched in any way. The rubber-sealing gasket must also be in good condition. Ensure all cables and optical fibers are clear of the edges of the lid and base. Refer all repairs to Pacific Broadband Networks' qualified service personnel.

Where an ODN2000 plug-in module is used, spiral binding should be used to bind together the power cable and the two RF cables (Figure 5-7) to reduce the possibility of them being caught between the lid and base when closing.

Once all the above steps are completed, the node can be closed. When closing the node, tighten the mounting screws in the order shown in Figure 5-8 (1→2→3→4→1).

Note:

The IP67 rating of the ODN2000 is dependent on the proper sealing of all external node interfaces. This includes the optical stub cable and all RF connectors.

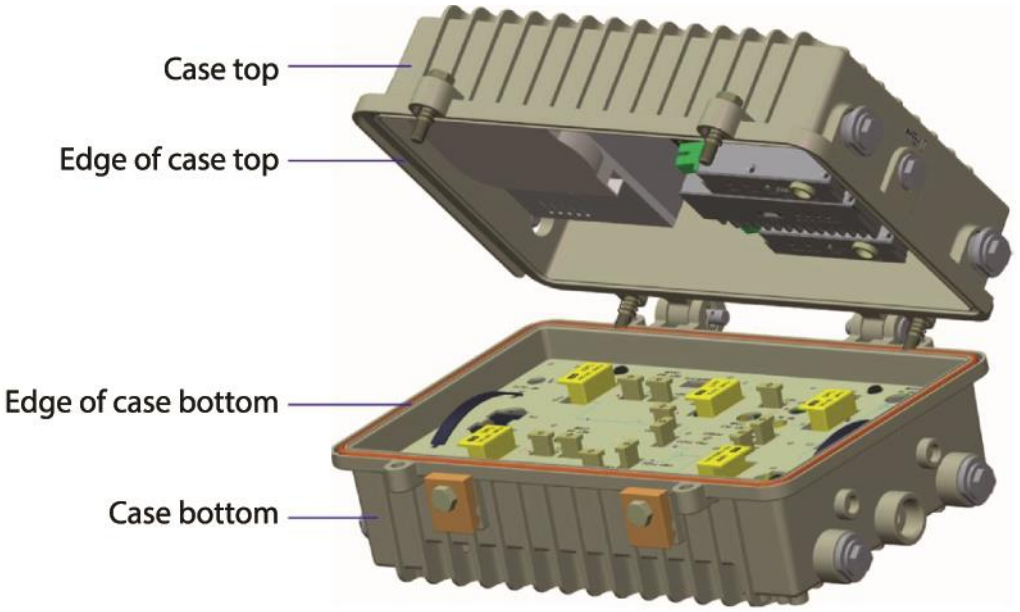

Figure 5-6 ODN2000 Node Casing

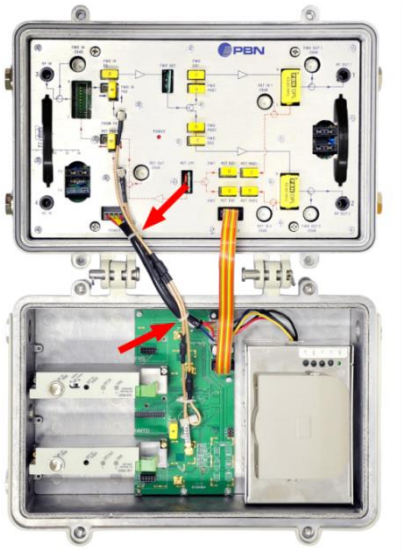

Figure 5-7 Internal Cabling Secured with Cable Ties

Figure 5-8 Screw Tightening Order

5.4 Module Installation & Removal

The ODN2000 modules plug into the backplane of the node's circuit board. To avoid causing any damage, be careful with the pins located underneath each module during its insertion or removal.

5.4.1 Module Removal

Use the following procedure to remove an ODN2000 module during maintenance or replacement:

a) Disconnect all cables and wires.

b) Unscrew the two anchor screws that hold the ODN2000 module in place (Figure 5-9).

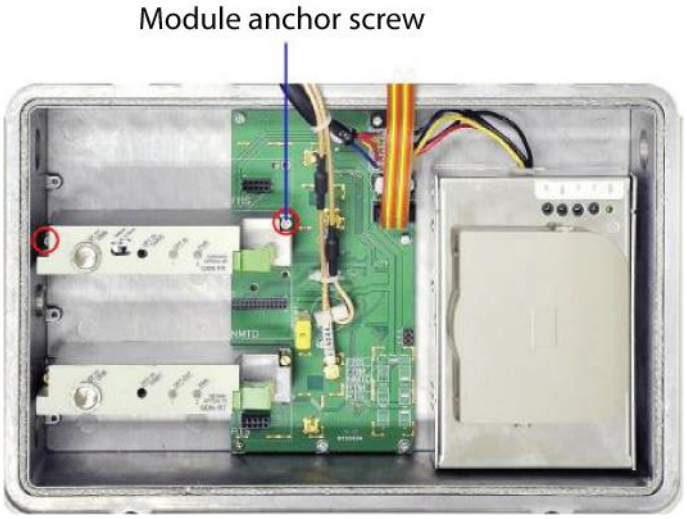

Figure 5-9 Module Anchor Screws

c) Vertically, lift the module firmly. Refrain from using excessive force. The module should be lifted out at ease.

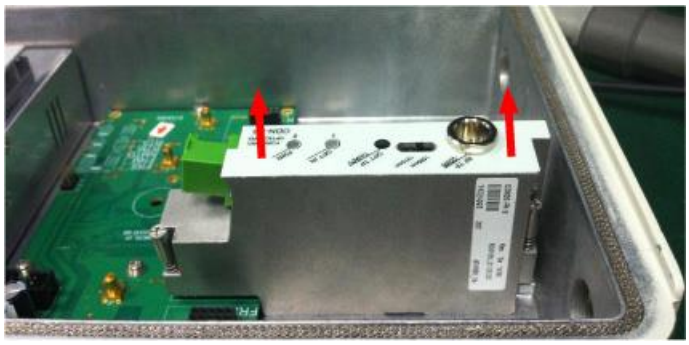

Figure 5-10 Module Removal

5.4.2 Module Insertion

Use the following procedure to install an ODN2000 module during maintenance or replacement:

a) On the backplane of the circuit board in the ODN2000 node's module compartment, locate the white rectangles (pointed to with red arrows in Figure 5-12). The module should be installed into the slot specifically designed for it.

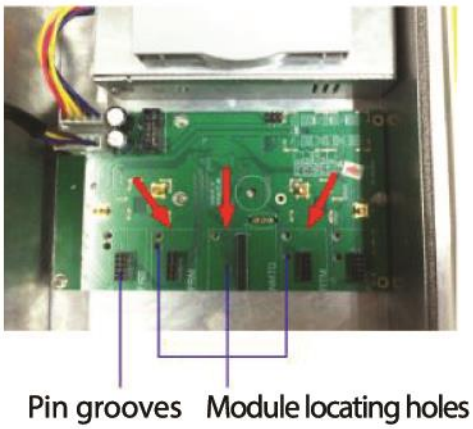

Figure 5-11 Backplane

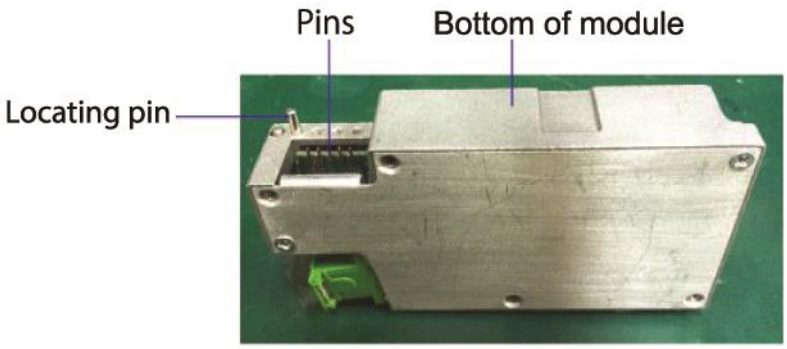

Figure 5-12 Module Locating & Contact Pins

b) Align the sides of the modules and the edges of the white rectangles on the backplane, locating pins and respective holes, contact pins and respective pin grooves.

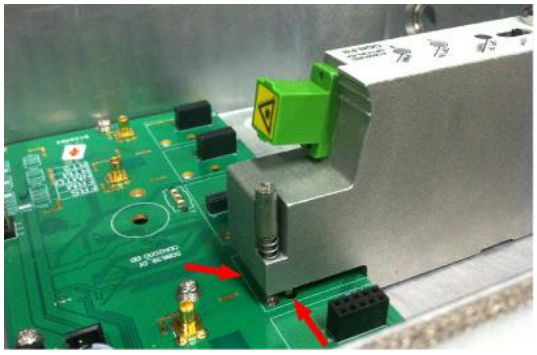

Figure 5-13 Aligning the Module

c) The pins should not be obstructed by cables or wires (specifically, the ODN-RT RF port test point cable).

d) Gently push down on the area of the module directly above the pins. The module should slip into place with ease. Refrain from using excessive force.

e) Screw in the two anchoring screws.

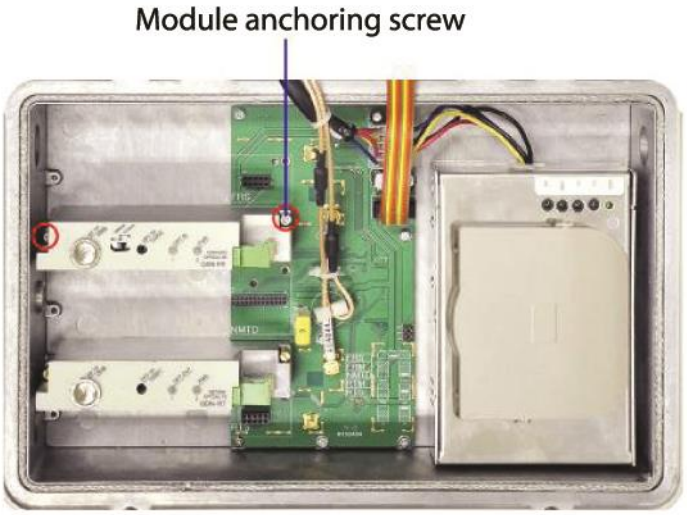

Figure 5-14 Two Anchoring Screws

6 Product Warranty

Pacific Broadband Networks warrants the ODN2000 and LE2000 for a period of one year from the date of shipment. The liability of Pacific Broadband Networks under this warranty is solely limited to repair and replacement.

Pacific Broadband Networks is not liable for DFB Laser failure after 90 days from receipt of item. Any claim for DFB Lasers will be presented to the laser vendor for replacement. Pacific Broadband Networks will make every effort to replace faulty lasers, although the ultimate judgment is at the laser vendor’s discretion.

Repairs referred to Pacific Broadband Networks' qualified service personnel must meet the following conditions:

1. The warranty registration has been completed and received by Pacific Broadband Networks.
2. PBN’s helpdesk is promptly notified in writing or by telephone that a failure has occurred or a defect was found.
3. PBN has determined that the equipment was not abused, misused, or operated under conditions outside manufacturer’s specifications.
4. When returning a product, the return authorization number obtained from PBN must be clearly marked on the product or the outside of the shipping container and the package must include all relevant documents.
5. The customer is responsible for all shipping and handling charges. C.O.D. and freight collect will not be accepted without prior approval from PBN.

The warranty does not cover the following:

1. Products purchased from someone other than PBN or an authorized PBN dealer.
2. Damage caused by accident, negligence, misuse, abuse, improper operation, or failure to operate the equipment within the manufacturer’s specifications.
3. Damage caused by fluctuation in electrical current, lightning, power surges, etc.
4. Damage resulting from an overhaul, repair, or attempt to repair caused by someone other than PBN’s qualified service personnel.
5. Any product for which the serial number has been defaced, modified, or removed.
6. Any product that has been opened or modified without prior written permission from PBN.
7. Replacement of parts necessitated by normal wear and tear.
8. Any consequential or implied damages.

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